FOOD AND FEEDING HABITS OF FINGERLINGS AND JUVENILES OF MAHSEER (*TOR PUTITORA* HAM.) IN NAYAR RIVER[1]

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(*With three text-figures*)

The food and feeding habits of the fingerlings and juveniles of *Tor putitora* inhabiting river Nayar were studied for one year.
Observations on the nature of food and feeding habits indicated them to be "monophagic" and "column feeder". Inspite of the fact that the RGL values supported its omnivorous habit, the percental value of insect food item and their occurrence in 5% of the fishes clearly indicated a *"Carnivorous"* habit.

INTRODUCTION

The present contribution deals with the food and feeding habits of Garhwal mahseer (*Tor putitora* Ham.). Recent contributions in this field are by Das & Pathani (1978), on the adaptation of alimentary tract in relation to the feeding habits, Pathani & Joshi (1979) on the food and feeding habits of the fingerlings of *Tor tor* and *Tor putitora,* and Badola & Singh (1980) on food and feeding habits of fishes belonging to genera *Tor, Puntius* and *Barilius.*

Bearing in mind the significance of such data it was felt desirable to investigate the food and feeding habits of the fingerlings and juveniles of *Tor putitora* inhabiting river Nayar. This river was chosen for study as it harbours a large population of mahseer juveniles throughout the year suggesting its high productivity (Nautiyal & Lal 1978).

MATERIALS AND METHODS

For analysing the food and feeding habits of the mahseer, fish were procured at regular monthly intervals for one year from river Nayar. After measuring the length and weight the entire specimen was fixed in 5-7% formalin and brought to the laboratory. The fish available during these months ranged from 40.0 mm to 354 mm. Those ranging from 40.0 mm to 70.0 mm were considered as fingerlings and those above, as juveniles.

After recording the morphometric data, the fish was dissected and gut contents were examined for food habits. The fish being a typical cyprinid lacks the conventional stomach and as in others possesses an intestinal swelling in the anterior part, called "the intestinal bulb." The entire gut was taken out and moisture was removed by blotting paper. The total length of the gut was measured for determining Relative Gut Length (RGL) which was calcu-

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lated as the ratio of intestinal length to total body length. The "intestinal bulb" was then separated, weighed and then reweighed after evacuating its contents into a petri-dish. Their difference gave the weight of the entire gut contents. Volume of the food was recorded by displacement method. From the average data thus obtained the "Gastro-Somatic Index" (GSI) was determined for each fish to study the seasonal variations in food by the formula:

$$GSI = \frac{\text{Weight of the stomach contents}}{\text{Weight of the fish}} \times 100$$

The percentage of food composition was detected by the points method. While allotting points to the different food items the size of the fish and state of the intestinal bulb were taken into consideration. Points were allotted on their relative volumes as assessed by visual estimation and converted into percentages.

The feeding intensity was assessed by classifying the intestinal bulbs as Full, $\frac{3}{4}$ Full, $\frac{1}{2}$ Full, $\frac{1}{4}$ Full, Poor and Empty, and were awarded 20, 15, 10, 5, 2.5 and 0 points respectively, depending on the state of distention of stomach and amount of food in it. "Feeding Index" (Tham Ah Khow 1950) was calculated to express the feeding intensity.

The annual percentage of occurrence of the different food items in the guts was assessed by the Occurrence method (Allen 1935, Frost 1939, 1946). They were graded by the "Index of Preponderance" (Natrajan & Jhingran 1961).

Macroscopic and Microscopic examinations of the gut contents were made to identify the food items. In spite of this, to ensure the qualitative analysis of the fish's diet, the intestinal as well as rectal portions were also examined.

Feeding habits were observed in the field but this was possible only during winter and early summer when water remained crystal clear most of the time.

Observations

Food and its nature

The examined gut contents of *Tor putitora* consisted of insects, their larvae and nymphs along with plant debris, worms, sand and fish remains. Insects formed the highest percental value (Fig. 1) as compared to the other items, annually.

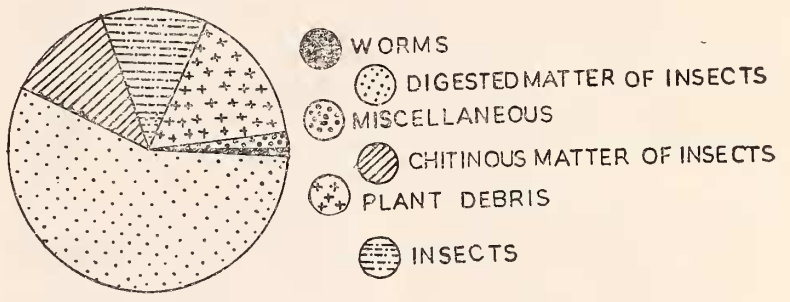

Fig. 1. Pie diagram showing percentage annual feed of *Tor putitora.*

1. *Insects* : Insects constituted the major part completely intact or slightly damaged insects, their larvae and nymphs were categorised as insects, their undigested remains which included legs, wing pads etc. were termed as chitinuous matter, and the digested portion which had the look of white torn flesh was identified and classified as the digested matter of the insects. In the present paper, in order to make an easy interpretation all the three items were grouped as insect matter. It was recorded that 73.5% of the fish had insect matter in their guts.

The insects constitute 81.7% of the gut contents annually. Microscopic and macroscopic examinations of the gut contents revealed that the fish feeds on the nymphs of may-flies and stone-flies, larvae of caddis-flies, and other aquatic insects along with the adults of water bugs.

2. *Plant debris* : During monsoon the surface run-off along with high velocity of water in

the streamlets bring either broken twigs or even branches of shrubs and trees growing on their banks, into the river. Small, granular particles were present in the intestinal bulb and identified as epidermal cells of plants and was thus termed as "plant debris". It constituted 15.9% of the gut contents annually and was present only during the month of August, 1980 and July, 1981 in 7.7% of the fish collected.

3. *Worms* : The worms which were often present in the gut have been considered as gut contents, but not as food, for they were parasites. This was confirmed by dissecting out the alimentary canal of the freshly killed specimens in which the worms were found to be alive. They were in higher percentage in the intestinal bulbs possessing only digested matter. They constituted 0.8% of the gut contents, annually and were present in 12.0% of the fish.

4. *Miscellaneous* : The items included in this category were sand and fish remains (vertebrae, scales, dermal bones etc.) which constituted a major part as compared to fish remains which were found only during May. These items were present in 6.8% of the fish.

Feeding Intensity : The feeding intensity as is evidenced by the "Feeding Index" varies from month to month (Fig. 2). It was also observed to differ with the length of the fish (Table 1) for the fishes ranging from 40.0-90.0 mm were observed to possess higher feeding intensity. The intensity however fell after the fish attains the length of 190.0 mm or more.

Relative Gut Length: The relative gut length ranged from 0.819 to 0.918 in fingerlings and from 1.056 to 1.825 in the juveniles (Table 2).

TABLE 1

FEEDING INDEX VALUES FOR DIFFERENT LENGTH GROUPS OF *Tor putitora*

40.0-90.0	64.9
91.0-140.0	34.3
141.0-190.0	40.0

TABLE 2

RELATIVE GUT LENGTH VALUES FOR *Tor putitora* FROM RIVER NAYAR

Months	RGL Values
August	1.056
September	1.406
October	0.819
November	0.868
December	0.918
January	1.159
February	1.454
March	1.301
April	1.556
May	1.675
June	1.825
July	0.835

DISCUSSION

The food and feeding habits of *Tor putitora* inhabiting high altitude Kumaun lakes and the hill streams of Garhwal Himalayas have been worked out by some authors.

Based on the Relative Gut Length values, position of the bile duct and percentage of the food items, Das & Pathani (1978) have considered it to be an "herbi-omnivore". Its fingerlings have been declared by Pathani & Joshi (1979) to be of "zoophagus nature". Badola & Singh (1980) have assessed *Tor putitora* to be a "carni-omnivore". However, observations our differ from those made by these authors. The investigations revealed that the insect matter ranked first and was considered as the "basis food" (Nikolsky 1963)

of the fingerlings as well as of the juveniles. Since the plant debris and the fish remains were consumed only in time of need, they were

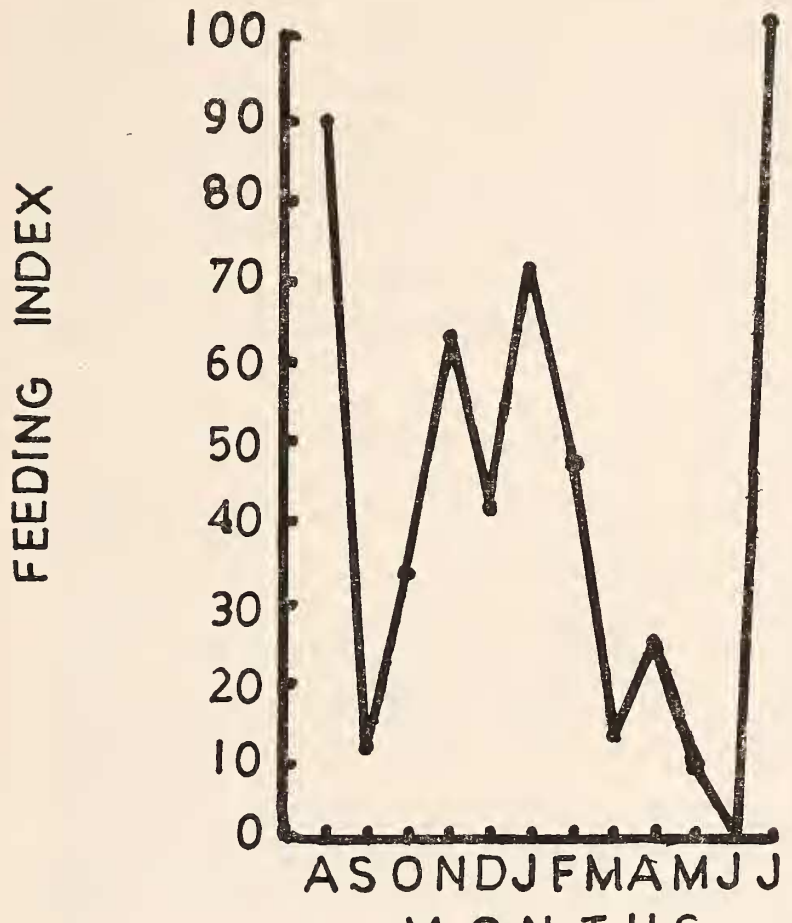

Fig. 2. Variations in the feeding intensity of *Tor putitora.*

categorised as "obligatory food" (Nikolsky 1963). Among the insects the Ephemeropteran

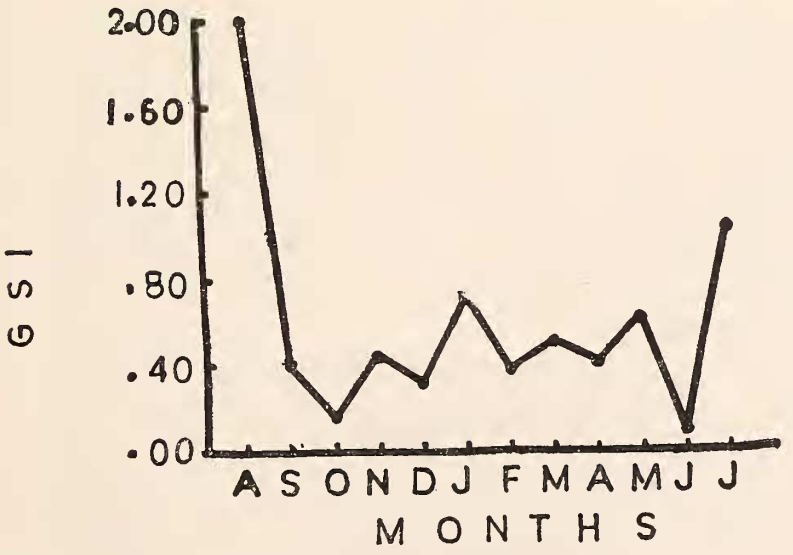

Fig. 3. Gastro-Somatic Index. Quantitative variations in the Diet of *Tor putitora.*

nymphs dominated, followed by Trichopteran and other insect larvae. Plecopteran nymphs were present occasionally, while hemipteran and coleopteran adults were rarely found.

The GSI exhibited no marked seasonal variation throughout the year, except for the month of August (Fig. 3) which can be attributed to intensive feeding by the young ones.

Feeding intensity has been worked out by some authors applying the fullness method (Frost, 1939, and a few others). Hynes (1950) has determined the extent of feed by considering the state of stomachs. Tham Ah Khow (1950) has propounded the "Feeding Index" based on the number of 3/4 and full stomachs while Lal & Dwivedi (1969) have determined the feeding intensity by the number of empty stomachs. The feeding index has been successfully applied by Venkataraman (1960) and Toor (1964). In the present case the maximum feeding intensity in *Tor putitora* was recorded during July and August. During these two months the fingerlings were available which evidently being young stages fed voraciously (Table 1). However, if the juveniles are taken into consideration, from September onwards the index exhibits a peak in January after which it gradually went down to minimum in May.

Feeding habits

The fingerlings were mostly found in the lee of flooded pools during monsoon and thus feed on some plants which get submerged in them. However, the juveniles feed actively in shoals during early morning hours. They were observed to feed on the river margins but switched over to the middle section during day. While feeding on insects they scrape the stones with the help of their lower jaw. Juveniles which have attained larger size were usually solitary in habit and inhabited the deeper pools.

The fish is thus "marginal-cum-mid" or "column feeder."

The mid- or bottom feeders may be herbivores, omnivores, or carnivores in nature (Das & Moitra 1963). The Garhwal mahseer, as is evidenced by the inferior pharyngeal teeth (Nautiyal *et al.* 1980) and the RGL values, seems to be omnivores in nature. If the percental values of the gut contents are taken into consideration its "insectivorous" nature cannot be denied. The term insectivore (Khanna & Pant 1964) has been included in the category of carnivores (Das & Moitra 1963).

In the case of *Tor putitora,* insect matter constituted 81.7% and the plant matter 15.9% of the annual feed. The latter was occasionally present in the guts examined (during July and August) We thus concluded that the fish under investigation is a *"Carnivore"* by habit. The contradiction thus arising due to the comparison of the actual dietry habits of the fish with the RGL values supports the view that the fish can adapt to the diet available in the particular environment (Steven 1930, Pillay 1953, Martin 1954, Kapoor 1958 and Singh 1966). Also, that it is not always possible to relate fish's diet to the length of the alimentary canal (Al-Hussaini 1949). The herbi-omnivorous nature of the Kumaon mahseer has been reported to be a peculiar example of evolutionary transition from herbivorous to omnivorous nature (Das & Pathani 1978). Naturally, the Garhwal mahseer too seems to be a similar case exhibiting changes in the food habits from omnivorous to carnivorous habits, an adaptation to the environment of the Nayar river, a spring-fed hill-stream.

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